

Large Scale Deposition of TiC/a-C Nanocomposite Coatings by Magnetron Sputtering using Novel Ceramic Compound Targets

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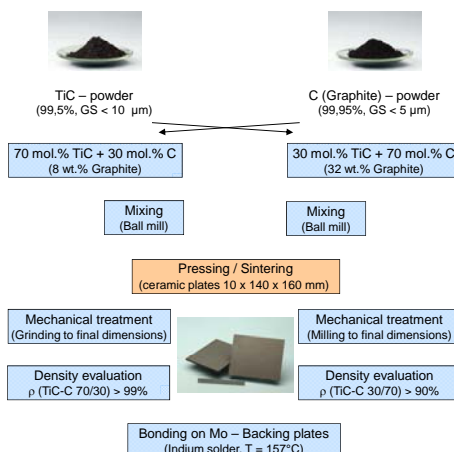
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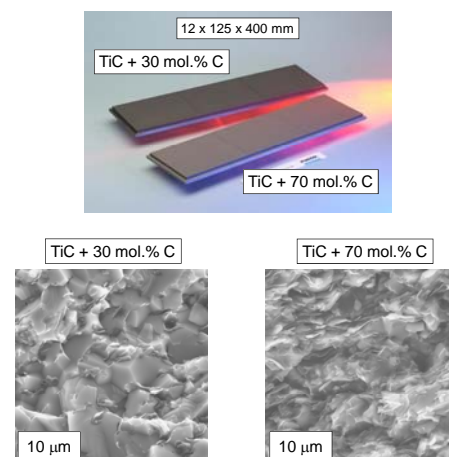
Motivation & Approach

Carbon-based nanostructured composite thin film materials such as TiC/a-C have attracted large scientific and technical attention with regard of their interesting properties, addressing not only tribological applications (by high wear resistance and simultaneously low friction coefficients) but also electrical, optical and many other applications. In the past few years the knowledge on the correlation between synthesis conditions, growth, microstructure and properties of these kind of materials has enormously increased. However, industrial applications have so far mainly been established for WC/a-C coatings in tool applications. This situation is partially related to the lack of appropriate processes for large scale deposition of such materials over a wide range of coating compositions and on complex shaped component geometry. In this work the large scale deposition of TiC/a-C nanocomposite coatings by means of non-reactive D.C. magnetron sputtering is reported. A novel process route on production level using innovative, newly developed hot-pressed ceramic compound targets of individual TiC:C compositions is presented.

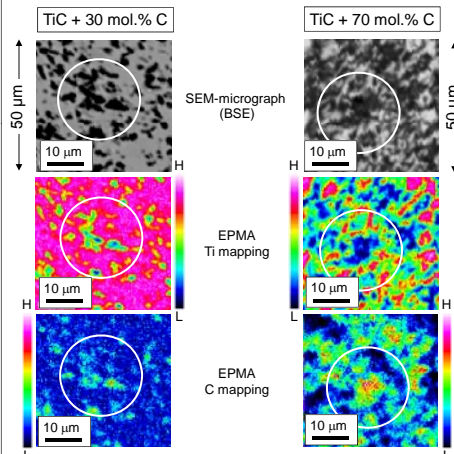
Target Manufacture



Target Characterization (I)

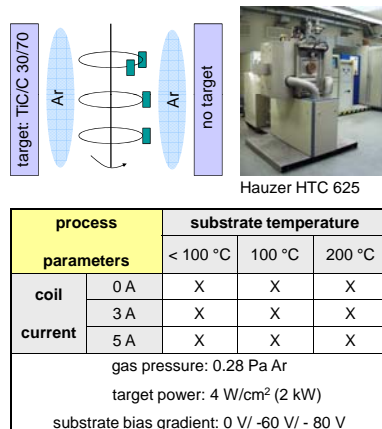


Target Characterization (II)

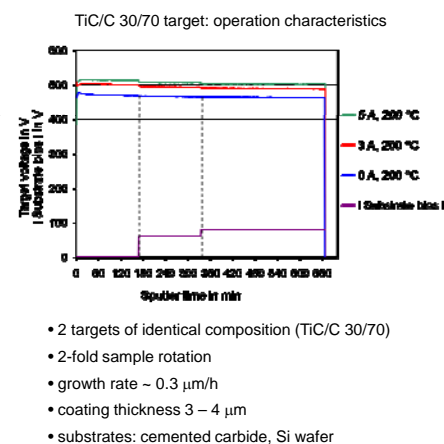


Thin Film Deposition (I)

Non-reactive D.C. magnetron sputtering of TiC/C 30/70 target



Thin Film Deposition (II)



TiC/a-C Nanocomposite Films (I)

Electron Probe Micro Analysis (EPMA)

Target no. 1 (TiC/C 30/70), substrate temperature < 100 °C

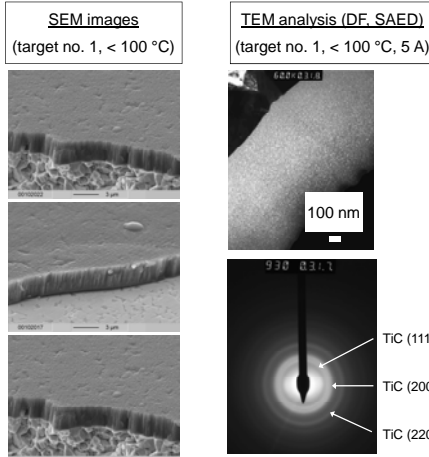
	analyzed elements in at. %					[Ti]/[C]
sample	[Ti]	[C]	[Ar]	[N]	[O]	
0 A	19.7	73.2	3.0	2.4	1.7	0.27
3 A	21.6	72.3	3.2	2.7	0.3	0.30
5 A	20.2	72.5	3.5	3.1	0.7	0.28

Target no. 2 (TiC/C 30/70), substrate temperature < 100 °C

	analyzed elements in at. %					[Ti]/[C]
sample	[Ti]	[C]	[Ar]	[N]	[O]	
0 A	20.5	72.1	3.2	2.9	1.3	0.29
3 A	22.0	72.5	3.1	2.1	0.3	0.30
5 A	22.1	71.2	3.4	2.7	0.5	0.31

target composition: 23.1 at.% Ti, 76.9 at.% C - [Ti]/[C] = 0.3

TiC/a-C Nanocomposite Films (II)



Conclusions

We have successfully demonstrated the large scale deposition of TiC/a-C nanocomposite coatings by means of non-reactive D.C. magnetron sputtering.

Novel ceramic TiC/C compound targets of various composition were successfully used for PVD deposition.

Reliable and reproducible deposition processes on pre-industrial level have been demonstrated.

The coating of complex 3D-shaped geometries at low substrate temperature was successfully demonstrated.

Use of ceramic compound targets for arc evaporation ?



Acknowledgement

We appreciate the target supply and cooperation with Plansee Composite Materials GmbH, and especially with Dr. Arno Schintlmeyer, Technical University of Vienna.